

CLAIMS

What is claimed is:

1. A method performed in an atomic layer deposition (ALD) process conducted in a process chamber, the method comprising:

5 supplying a gas to the process chamber;

varying a flux of the gas to a substrate an ALD process by varying the chamber conductance.

2. The method of Claim 1 wherein varying the chamber conductance comprises varying an area of an opening between a process region and a lower pressure
10 volume outside the process region.

3. The method of Claim 1 wherein varying the chamber conductance varies the flux of ions to the substrate in the ALD process.

4 The method of Claim 1 wherein varying the chamber conductance varies the flux of reactive atoms to the substrate in an ALD process.

15 5. The method of Claim 1 wherein the flux of the gas on the substrate varies inversely with the chamber conductance, such that the flux of the gas on the substrate increases when the conductance decreases.

6. The method of Claim 1 wherein the pressure in the process region varies inversely with the chamber conductance.

20 7. The method of Claim 1 wherein varying the chamber conductance comprises periodically varying the conductance.

8. The method of Claim 7 wherein said periodically varying the conductance varies the conductance between relatively low and relatively high conductances.

9. The method of Claim 8 further comprising generating ions during low conductance periods.

10. The method of Claim 8 further comprising generating reactive atoms during low conductance periods.

5 11. The method of Claim 8 further comprising generating a plasma during low conductance periods.

12. The method of Claim 11 further comprising applying RF power within the process chamber during low conductance periods to generate the plasma.

10 13. The method of Claim 12 wherein applying RF power to generate a plasma comprises applying a constant RF power while increasing chamber pressure, by lowering chamber conductance, to ignite the plasma, the method further comprising:

extinguishing the plasma by decreasing chamber pressure, by increasing chamber conductance.

15 14. The method of Claim 1 wherein said varying a flux is part of a deposition sequence, the deposition sequence comprising separating each of a plurality of low conductance periods from one another by one of a plurality of high conductance periods.

15. The method of Claim 1 wherein said varying a flux is part of a deposition sequence for depositing a thin film onto the substrate in the process chamber, the deposition sequence comprising:

20 introducing a first reactant gas into the chamber;

forming at least one monolayer on the substrate by adsorption of the first reactant gas;

increasing the conductance out of the process region;

decreasing the conductance out of the process region;
introducing at least one ion generating feed gas into the chamber;
generating a plasma from the ion generating feed gas to form ions;
exposing the substrate to the ions;
5 modulating the ions;
reacting the monolayer with the ions to deposit the thin film;
increasing the conductance out of the process region;
evacuating excess ion generating feed gas from the chamber; and
decreasing the conductance out of the process region.

10 16. The method of Claim 1 wherein said varying a flux is part of a deposition sequence for depositing a thin film onto the substrate in the process chamber, the deposition sequence comprising:

introducing a first reactant gas into the chamber;
forming at least one monolayer on the substrate by adsorption of the first
15 reactant gas;
increasing the conductance out of the process region;
decreasing the conductance out of the process region;
introducing at least one reactive atom generating feed gas into the chamber;
20 generating a plasma from the reactive atom generating feed gas to form reactive atoms;
exposing the substrate to the reactive atoms;

modulating the reactive atoms;

reacting the monolayer with the reactive atoms to deposit the thin film;

increasing the conductance out of the process region;

evacuating excess reactive atom generating feed gas from the chamber;

5 and

decreasing the conductance out of the process region.

17. The method of Claim 1 further comprising introducing a purge gas to the process region and varying the chamber conductance.

10 18. The method of Claim 17 wherein varying the chamber conductance comprises periodically varying the conductance between relatively low and relatively high conductances, wherein high conductance periods occur at the beginning and end of each purge gas pulse with a period of low conductance in-between.

19. In a deposition process performed in a process chamber having a process region, a method comprising:

15 introducing a gas into the process region for a first duration;

increasing the conductance out of the process region for a second duration;

introducing at least one additional gas;

decreasing the conductance out of the process region for a third duration;

and

20 increasing the conductance out of the process region for a fourth duration.